

## CLAIMS

What is claimed is:

1. A method for forming a catalyst, comprising:
  - (a) contacting a support material with a metal-containing compound to form a catalyst precursor, wherein the support material comprises boehmite having an average crystallite size of from about 4 nm to about 30 nm; and
  - (b) treating the catalyst precursor to obtain a catalytic metal oxide from the catalytic metal-containing compound and to obtain a catalyst support from the boehmite.
2. The method of claim 1 wherein the average crystallite size is in a range of from about 6 nm to about 30 nm.
3. The method of claim 1 wherein the average crystallite size is in a range of from about 8 nm to about 25 nm.
4. The method of claim 1 wherein the average crystallite size is in a range of from about 10 nm to about 20 nm.
5. The method of claim 1 wherein the boehmite comprises a mixture of a first boehmite material having a first average crystallite size and a second boehmite material having a second average crystallite size.
6. The method of claim 5 wherein the first average crystallite size is at least about 1 nm smaller than the second average crystallite size.
7. The method of claim 5 wherein the first average crystallite size is at least about 3 nm smaller than the second average crystallite size.
8. The method of claim 5 wherein the first average crystallite size is at least about 5 nm smaller than the second average crystallite size.

9. The method of claim 5 wherein the first average crystallite size is in a range of from about 4 nm to about 15 nm, and wherein the second average crystallite size is in a range of from about 10 nm to about 30 nm.
10. The method of claim 9 wherein a weight ratio of the first boehmite material to the second boehmite material is in a range of from about 1:99 to about 99:1.
11. The method of claim 10 wherein the weight ratio the first boehmite material to the second boehmite material is in a range of from about 1:3 to about 3:1.
12. The method of claim 10 wherein the weight ratio of the first boehmite material to the second boehmite material is about 1:1.
13. The method of claim 5 wherein the first boehmite has an average crystallite size between about 4 and about 10 nm; and the second boehmite has an average crystallite size between 8 nm and 30 nm.
14. The method of claim 13 wherein a weight ratio of the first boehmite material to the second boehmite material is in a range of from about 1:99 to about 1:4.
15. The method of claim 13 wherein a weight ratio of the first boehmite material to the second boehmite material is in a range of from about 1:99 to about 5:95.
16. The method of claim 5 wherein the first boehmite has an average crystallite size between about 8 and about 20 nm; and the second boehmite has an average crystallite size between 20 nm and 30 nm.
17. The method of claim 16 wherein a weight ratio of the first boehmite material to the second boehmite material is in a range of from about 4:1 to about 99:1.

18. The method of claim 16 wherein a weight ratio of the first boehmite material to the second boehmite material is in a range of from about 99:1 to about 95:5.
19. The method of claim 1 wherein the catalyst support comprises a stabilized aluminum oxide structure.
20. The method of claim 19 wherein the stabilized aluminum oxide structure comprises gamma-alumina.
21. The method of claim 1, further comprising pretreating the support material before said contacting the support material with the catalytic metal-containing compound.
22. The method of claim 21 wherein the pretreating comprises spray-drying.
23. The method of claim 21 wherein the pretreating comprises preheating at a temperature of from about 250 °C to about 350 °C.
24. The method of claim 21 wherein the pretreating comprises spray-drying and preheating at a temperature of from about 300 °C to about 350 °C.
25. The method of claim 1 wherein said treating the catalyst precursor comprises calcining the catalyst precursor to convert at least a portion of the catalytic metal-containing compound to a metal oxide and at least a portion of the boehmite to a stabilized aluminum oxide structure.
26. The method of claim 25 wherein the calcining is performed at a temperature of from about 200 °C to about 800 °C.
27. The method of claim 25 wherein the calcining is performed at a temperature of from about 350 °C to about 800 °C.
28. The method of claim 25 wherein the calcining is performed at a temperature of from about 450 °C to about 800 °C.

29. The method of claim 25 wherein said treating the catalyst precursor further comprises reducing the metal oxide to form the catalytic metal.
30. The method of claim 1 wherein the catalytic metal is selected from a group consisting of cobalt, iron, nickel, ruthenium, and combinations thereof.
31. The method of claim 1, wherein the catalytic metal is cobalt.
32. A catalyst made by the method of claim 1.
33. A process for producing hydrocarbons, comprising: contacting a catalyst with carbon monoxide and hydrogen in a reaction zone to produce one or more hydrocarbons, wherein the catalyst is made by a method comprising:
- (a) contacting a support material with a catalytic metal-containing compound to form a catalyst precursor, wherein the support material comprises bohemite having an average crystallite size of from about 4 nm to about 30 nm; and
  - (b) treating the catalyst precursor to obtain a catalytic metal oxide from the catalytic metal-containing compound and to obtain a catalyst support from the bohemite.
34. The process of claim 33 wherein the average crystallite size is in a range of from about 6nm to about 30 nm.
35. The process of claim 33 wherein the average crystallite size is in a range of from about 8 nm to about 30 nm.
36. The process of claim 33 wherein the average crystallite size is in a range of from about 10 to about 20 nm.
37. The process of claim 33 wherein the boehmite comprises a mixture of a first boehmite material having a first average crystallite size and a second boehmite material having a second average crystallite size.

38. The process of claim 37 wherein the first average crystallite size is at least about 1 nm smaller than the second average crystallite size.
39. The process of claim 37 wherein the first average crystallite size is at least about 3 nm smaller than the second average crystallite size.
40. The process of claim 39 wherein the first average crystallite size is at least about 5 nm smaller than the second average crystallite size.
41. The process of claim 37 wherein the first average crystallite size is in a range of from about 4 nm to about 15 nm, and wherein the second average crystallite size is in a range of from about 10 nm to about 30 nm.
42. The process of claim 41 wherein a weight ratio of the first boehmite material to the second boehmite material is in a range of from about 1:99 to about 99:1.
43. The process of claim 37 wherein the first boehmite has an average crystallite size between about 4 and about 10 nm; and the second boehmite has an average crystallite size between 8 nm and 30 nm.
44. The process of claim 43 wherein a weight ratio of the first boehmite material to the second boehmite material is in a range of from about 1:99 to about 1:4.
45. The process of claim 37 wherein the first boehmite has an average crystallite size between about 8 and about 20 nm; and the second boehmite has an average crystallite size between 20 nm and 30 nm.
46. The process of claim 45 wherein a weight ratio of the first boehmite material to the second boehmite material is in a range of from about 99:1 to about 4:1.
47. The process of claim 33 wherein said treating the catalyst precursor comprises calcining the catalyst precursor to convert at least a portion of the catalytic metal-

containing compound to a metal oxide and to convert at least a portion of the boehmite to a stabilized aluminum oxide structure.

48. The process of claim 47 wherein the calcining is performed at a temperature of from about 200 °C to about 800 °C.

49. The process of claim 47 wherein the calcining is performed at a temperature of from about 350 °C to about 800 °C.

50. The process of claim 47 wherein the calcining is performed at a temperature of from about 450 °C to about 800 °C.

51. The process of claim 47 wherein said treating the catalyst precursor further comprises reducing the metal oxide to form the catalytic metal.

52. The process of claim 33 wherein the catalytic metal comprises cobalt, iron, nickel, ruthenium, or combinations thereof.

53. The process of claim 33 wherein the hydrocarbons comprise hydrocarbons with 5 or more carbon atoms.

54. The process of claim 33 wherein the hydrogen and the carbon monoxide are produced via catalytic partial oxidation of gaseous hydrocarbons.

55. The process of claim 33, further comprising processing the hydrocarbons into at least one of diesel, naphtha, kerosene, and combinations thereof.